

## **Doubting Conventional Reality: Interactive Mind Works**

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# Doubting Conventional Reality

## *Interactive Mind Works*

LYNDEN STONE

ABSTRACT

Quantum mechanics sits uncomfortably with “conventional reality,” defined as knowable, objective and mind-independent. There seems to be no consensus among physicists as to what the findings of quantum mechanics mean for conventional reality. Drawing on concepts of quantum mechanics, the author makes artworks that provoke viewers to doubt conventional reality. Here, she discusses two of her interactive “mind works,” which provide not only artistic metaphorical representations of quantum concepts but also quantum random events that allow viewers to test their beliefs, or otherwise, in a reality that is objective and mind-independent.

### THE PROBLEM QUANTUM MECHANICS POSES FOR CONVENTIONAL REALITY

Quantum mechanics has been described by physicists as one of the “two great pillars of twentieth-century science” [1] (the other being Einstein’s theory of gravity [2]) and “the fundamental underpinning of all modern science” [3]. However, despite the fact that quantum mechanics has been accurate in explaining a vast range of phenomena, physicists have failed to agree on exactly what the nature of quantum behavior means for our understanding and experience of conventional reality.

According to theoretical physicist and philosopher of science Bernard d’Espagnat, conventional reality assumes a knowable, objective and mind-independent universe [4]. And this is the way I usually experience reality: as an objective, ultimately knowable, physical world that exists outside my mind and seemingly is not just a creation of it.

Quantum mechanics poses serious challenges to conventional reality. According to the orthodoxy of quantum mechanics, elementary particles exist in states of “superposition” of multiple possibilities of “wave/particle duality,” the physical nature of which cannot be ascertained until they are observed or measured. Prior to measurement, they do

not exist in apparent material form. However, “wave/particle duality” is not an accurate description of quanta since quanta have no physical properties. More precisely, the idea of wave/particle duality reflects the *result* that we see in the macroscopic world once quantum behavior has been observed or recorded. That is, quanta either are observed as particles or exhibit wave-like behavior in the macroscopic world. The dual wave/particle nature of quanta and the effect of observation (or measurement) has been extensively tested and confirmed by the “double-slit” experimental method [5].

I do not experience the world as superposed multiple possibilities of waves and particles. Rather, my world seems to be one where the wavefunction has collapsed into single material actuality [6]. The process (known as the “measurement problem”) of how quantum superposition collapses (if, in fact, it does) is not presently understood. Various theories can be grouped into two propositions: either quantum superposition *does* or *does not* collapse. The main competing collapse theories propose that collapse is caused by the act of measurement or observation (regarded as the orthodox theory of collapse) [7] or, more controversially, via consciousness [8] or brain processes [9] of the observer, or, alternatively, by decoherence [10], that is, by quanta mixing with the macroscopic environment (without the necessity for an observer). This last theory of environmental collapse attempts to retain some level of objective reality into the ontology of quantum mechanics but the mechanism for collapse is yet to be established. Overlaying the “collapse/no-collapse” debate, however, is a body of increasing experimental results demonstrating quantum superposition at scales now readable with the naked eye [11]. The line between superposition and collapse is unclear.

In two polls undertaken at different foundational physics conferences in Europe in 2011 and 2013 (with notably different agendas and different attendees), the pollsters concluded that there was no consensus amongst those polled at each conference on essential quantum theoretical questions [12] and that there was significant controversy on fundamental

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issues [13]. While the polls do not claim to be representative of the community at large, they do indicate that those polled hold a range of opinions concerning the ontological foundations of quantum mechanics. At least a quarter in both groups polled thought that the “measurement problem” (of how, and if, quantum superposition collapses) was a “severe difficulty”; although, countering this view, as many as 27% of those polled in the 2011 survey thought it was a “pseudoproblem.” The more objective/rational explanation of decoherence as solving the measurement problem was supported by only 15% of respondents of the 2011 respondents and 3% of respondents in the 2013 poll. However, over a third of those polled in 2011 and half of those in 2013 indicated that the measurement problem “was solved or would be solved in a different way.”

One of the different solutions to the measurement problem, proposed by Nobel laureate and Princeton University physicist Eugene Wigner, is that human consciousness is the active agent of collapse of quantum superposition [14]. Wigner postulated that only the intervention of human consciousness can break the infinity of unobserved quantum possibilities to register a definite response [15].

Wigner was troubled by the formalism of superposition, which indicated that multiple, interlocking systems could join to form larger sets of superposition [16]. For example, it could be said that the experiment + measuring apparatus + the observer + the laboratory could all form one larger state of superposition to an observer outside the system. If further systems could be added on ad infinitum, at what point does this final observation and collapse of superposition take place? To Wigner, this view seemed untenable with our experience of a single reality that we all for the most part seem to share and agree upon. Therefore, he considered that the being with consciousness must have a different role in quantum mechanics than the inanimate measuring device. So while everyone can potentially collapse superposition, once it collapses, it does so into the same reality for everyone.

Other high-profile physicists and mathematicians hold the view that consciousness is the active agent in collapse of superposition [17]. However, they remain in the minority. (In 2011, a summary of well-known physicists’ opposition to observer-caused collapse appeared in an article in the *Journal of Cosmology* [18].) In the 2011 poll of thirty-three participants at the conference “Quantum Physics and the Nature of Reality” in Austria previously referred to, 42% supported collapse of superposition by observation. However, only 6% thought the observer’s consciousness caused collapse [19]. In the 2013 poll of seventy-six people at the conference “Quantum Theory Without Observers III,” 24% thought the observer played a fundamental role but only 1% thought the wavefunction collapse was caused by consciousness [20]. Possibly, the themes for the two polled conferences, and the resulting differences in attitude of attendees, account for the differences in these and the earlier referred to results. Nevertheless, collapse of quantum superposition by observation remains a possibility for some physicists and collapse by human consciousness, for a few.

## ENGAGING QUANTUM CONCEPTS TO ENABLE VIEWERS TO DOUBT CONVENTIONAL REALITY

The unresolved questions of how and why elementary particles in superposed, indiscernible apparent states of waves and particles collapse into a singular physical reality upon measurement or observation challenge the idea that “conventional reality” is objective, mind-independent and knowable [21]. A decades-long call has been emanating from the scientific community for a reevaluation of conventional reality [22]. The possibility (albeit highly controversial) that our conscious mind is the agent of superposition collapse might mean that reality is, in fact, highly subjective.

In part to respond to this decades-long call from the science community, and utilizing the provocative idea that consciousness might be the agent of collapse, my mixed media artworks engage a viewer to doubt conventional reality. Two artworks in my “mind works” series, the *Metaphase Typewriter revival project* and the *Mind dispenser*, offer viewers an opportunity to test their beliefs in an objective, knowable and mind-independent reality. Specifically, they engage with the controversial idea that an observer’s consciousness may collapse quantum wavefunctions from multiple, superposed states to a single material reality.

I make no claim that these works allow the viewer to affect or create material reality. Rather, they provide a facility to doubt conventional reality. A willingness by a viewer to engage with these artworks suggests that the viewer is prepared, at least for a short period, to suspend a belief in conventional reality. By interacting with the works, the viewer is instructed to use the mind or consciousness to affect the output of the mind works.

### The *Metaphase Typewriter revival project*

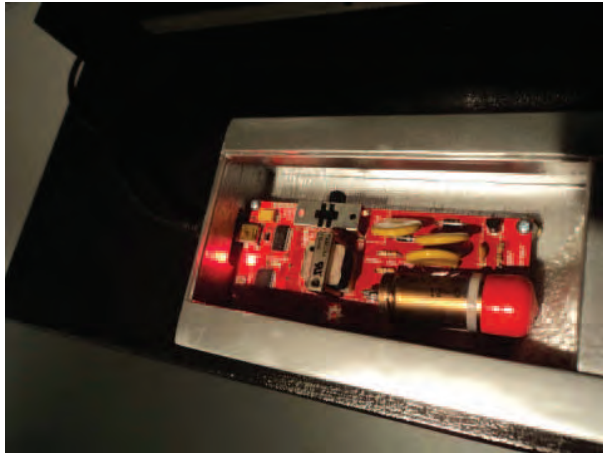
In February 2014, in the Webb Gallery at the Queensland College of Art, Brisbane, Australia, a laptop, its keyboard covered with black Perspex, is installed on a plinth. The viewer approaches, drawn in by its clicking sound, a blinking red light and continual lines of green 0s, 1s, numbers and text arriving at the bottom of the screen. The laptop’s text-to-voice reader announces the lines of words that appear against a black background. In front of the laptop, a silver box contains a gadget with a blinking red light. The viewer reads a notice affixed to the wall:

Use your mind to affect the output of words and sentences. Concentrate on the output of 0s and 1s being generated to replace the question marks at the bottom of the screen. Relax and be confident that you can affect the generation of these numbers to produce the words you want.

This is the *Metaphase Typewriter revival project* (2012) (Figs 1 and 2). The viewer is invited to interact with quantum random events (low-level radioactive decay) read by a Geiger counter to test the idea that consciousness might collapse quantum superposition to subjectively affect the words and sentences produced. This work is a recreation of American physicist Nick Herbert’s original “Metaphase Typewriter” [23]. In the 1970s, Herbert created his Typewriter to test



**Fig. 1.** *Metaphase Typewriter revival project*, Geiger counter, gas lamp mantle, laptop, program, Perspex cover, installation view, 2012. (© Lynden Stone)



**Fig. 2.** *Metaphase Typewriter revival project*, Geiger counter detail, 2012. (© Lynden Stone)

whether quantum physics could explain consciousness and the metaphysical spiritual realm. It comprised a radioactive source, a Geiger counter, a room of computers and a teletypewriter. A computer program converted the frequency of random intervals of radioactive decay at the quantum level into an output of letters from the teletypewriter based on their frequency of occurrence in the English language. Herbert invited psychics to try to influence the output of letters through metaphysical means. Although Herbert recorded little success, nevertheless, the *Metaphase Typewriter* represents the endeavors some physicists have made to link quantum mechanics with consciousness and the metaphysical that, arguably, stands outside our material world. I read about Herbert's *Metaphase Typewriter* in 2011 in David Kaiser's book *How the Hippies Saved Physics* [24] and subsequently contacted Herbert, receiving his permission to recreate his device as an artwork using contemporary technology.

My device contains a radioactive gas lamp mantle and a

Geiger counter (Fig. 2) connected to a laptop computer via USB. In response to radioactive decay (a quantum event), the Geiger counter generates random bits. These bits are converted (via a program written by collaborator M.U. Shrooms) into a number range that represents a word in a word list. The list is a modified version of the Corpus of Contemporary American English (a word list compiled by Mark Davies at Brigham Young University [25]). The more frequently occurring words, such as "the" "was" "a" have a much wider number range. Less frequent words are represented by a smaller number range or by just one number. Shrooms's program allows for the possibility that, as random words are produced, simple sentence structures may form.

The frequency of radioactive decay does not strictly equate to the frequency of a word in the word list. The radioactive decay as read by the Geiger counter is simply a random event that produces a random number. It does not reflect the time interval between each decay event. We would need to know the number of particles available and the usual/average rate of decay to add this into the program. Thus, to affect the output of a single word, a viewer's consciousness must, in theory at least, interact with the device at each bit generation to effect a specific result.

Anecdotally, several viewers reported to me that this artwork facilitated their doubting of conventional reality. For example, during my exhibition *No Singular Reality* [26] in April 2012, where the *Metaphase Typewriter revival project* was first exhibited, a viewer, after spending time with the device in the gallery, told me that it had "spooked" her "to the core" and she did not want to go near it again. In her mind, she perceived a connection with the output of words that had terrified her. One examiner of my PhD exhibition [27] requested a printout of the output of words from the *Metaphase Typewriter* from the time that he was in the gallery. This examiner told a third party, who then told me, that he considered the words produced by the device in his presence to have some relevance and correlation to his own circumstances.

When this work is exhibited, the outputs are also streamed live to the Internet via the website <[www.damon.com/mtrp](http://www.damon.com/mtrp)> (where all outputs from the project can still be viewed). One friend located in Alaska who interacted with the device streaming over the Internet reported to me that the words produced by the device had relevance to what he was thinking and intending.

In an unexpected way, my experience with the *Metaphase Typewriter revival project* facilitated my own doubting of conventional reality. In April 2012, I worked late into the evening to de-install the exhibition, leaving the *Metaphase Typewriter* running while I was taking down other artwork, patching holes and repainting. The text-to-voice reader's announcements of words and sentences kept me company for several hours. Finally, there was nothing left to do but shut down the program and turn off the computer. I was strangely reluctant and maudlin. I killed the switch. Checking later, the last output that night was oddly reflective of my own thoughts: It was i, i; into, death, the.

### Mind dispenser

Installed further along on the gallery wall is a lolly-dispensing machine. The viewer pushes the large red Start button and motors are activated to drive five horizontal augers that push gobstoppers along their spiral tubes. Five corresponding vertical tubes feed the augers, each with a different color of lolly. A bright, arcade-style sign above the machine reads:

#### THE MIND DISPENSER

Use your mind to choose the coloured lolly you want

After launching the device by pressing a large red button, the viewer watches the race of colored lollies. If willing to engage, the viewer is instructed to use their conscious will to guide the lolly of their choice to win the race into the dispensing tube. Once one lolly reaches the end of the auger, it drops into the dispensing tube and the process stops. A willingness to engage with the device, as in the *Metaphase Typewriter revival project*, indicates some sort of rupture in expected reality in the mind of the viewer. The viewer is at least prepared, for a short period, to suspend their belief that reality is objective and mind-independent; that they cannot have an effect on the outcome and get the colored lolly they choose.

The *Mind dispenser* (2013) (Figs 3 and 4) is a collaborative project with engineering student Anderson Tepas and Associate Steven O’Keefe, Head of Electrical and Electronic Engineering School at Griffith University, Brisbane. The device dispenses gobstoppers using electrical signals generated by a quantum random event generator (a Geiger counter reading random events of decay from a card of fluorescent wristwatch hands [assumed to contain thorium]). A four-bit system generates sixteen possible numbers (1 to 16), but only the numbers 1 to 15 are used. A microprocessor interprets the generated numbers and sends signals to one of five motorized augers that correspond to the range of numbers linked to the color of the gobstopper. The following generated numbers correspond to the following colors:

- 1, 2, 3: blue
- 4, 5, 6: green
- 7, 8, 9: yellow
- 10, 11, 12: pink
- 13, 14, 15: red

In theory, any number could be assigned to any color. However, we saw some logic and elegance in equating the numbers to the wavelengths of light colors. Accordingly, 1, 2 and 3 are assigned to blue, as blue light has the shortest wavelength. Green light has a longer wavelength than blue and is represented by the next three numbers, and so on.

Once one gobstopper out of the possible five is dispensed through the vertical dispensing tube, the augers reverse, resetting all undispensed lollies to the starting position.

The *Mind dispenser* should, over time, dispense the five colors of gobstoppers equally. However, as with my other mind works, my purpose is to provide a device where the viewer is given the opportunity to interfere with statistical probability and to will or intend a specific result. Specifically, to get the lolly of their choice (as for the other mind works) the controversial idea is that the viewer’s will *somehow in-*



**Fig. 3.** *Mind dispenser*, oil on board, Geiger counter, fluorescent wrist watch arms, microprocessor, motor drivers, optical detectors, wire, connecting board, pull type solenoids, plastic augers, metal and plastic lolly drop receiver, power supply, Perspex, gobstoppers, 2013. (© Lynden Stone. Photo © Renata Buziak.)



**Fig. 4.** *Mind dispenser*, 2013, installation shot. (© Lynden Stone. Photo © Renata Buziak.)

*teracts* with the quantum wavefunction to collapse superposition in the single actuality of the viewer’s choosing. A preparedness to embrace this idea, even momentarily, is the facilitation for the viewer doubting conventional reality.

When this work was exhibited in February 2014 [28], numerous people were prepared to interact with the work by using their concentrated intention to encourage their choice of colored gobstopper to win the race. Some people excitedly reported to me that they got their chosen color or, disappointedly, that they did not. One person told me they failed to get the color they wanted because other people queuing to have a turn of the *Mind dispenser* who were thinking of different colors “affected the result.”

### DOUBTING CONVENTIONAL REALITY

While the anecdotes of viewer interaction with the mind works provide no evidence that consciousness collapses quantum superposition, they indicate that these artworks have prompted viewers to doubt that reality is mind-independent. Additionally, my ambition is that viewers are prompted to

ponder the metaphors suggested by the mind works projects: that firstly *conscious observation may be the agent of collapse of quantum superposition*, and secondly and more radically, that *consciousness equates to physical matter*; that is, at the most basic level, conscious observation might equal or result in words appearing on the screen or a gobstopper being dispensed for the viewer to eat. While highly controversial, and not supported by mainstream physics, this metaphor recalls physicist John Archibald Wheeler's view of a "participatory universe" that emphasizes the role of the observer in creating observed phenomena. "The dependence of what is observed upon the choice of experimental arrangement," says Wheeler, "conflicts with the view that the universe exists 'out there' independent of all acts of observation" [29]. He thought that no phenomenon is a phenomenon until observed, and in this sense it is a "participatory universe" [30].

On the argument of a small but prominent minority of theorists, a willing engagement with the mind works may cause direct material results. One version of quantum theory accepts that observation or measurement causes collapse of pre-material quantum superposition into physical reality. On this basis, Werner Heisenberg thought quantum theory is an empirical theory and there is no physical reality beyond observation and measurement [31]. Based on the sugges-

tion that the agency of the observer's mind or consciousness causes quantum collapse [32], a handful of physicists go further to propose that consciousness is the method by which material reality is created [33]. Specifically *how* consciousness might collapse quantum superposition is the subject of several controversial theories ranging from brain processes [34], a specific "will channel" of the brain [35], conscious intentions [36] and unconscious mental influences [37].

For the greater success of the mind works, I would like to think that viewers *can* affect the output thereof by using only their consciousness to produce words and sentences or the color of the gobstopper that they intend. However, this does not matter, as the mind works act metaphorically as artworks to facilitate doubt of conventional reality, and not as science experiments. Regardless of whether consciousness is an active agent in collapse of quantum superposition, a willing engagement with any of the works means that there is a temporary suspension of the viewer's belief in conventional reality. Ultimately, viewers may fall back on, or never alter, their conviction on conventional reality. But the faculty of each of the artworks exists to enable a viewer to doubt a knowable, objective and mind-independent reality.

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